



**WILDLIFE WATER DEVELOPMENT  
TEAM REPORT  
2002**

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## **SECTION I. EXECUTIVE SUMMARY**

### **The Team**

The Water Development Team is a new, interdisciplinary approach to analyzing the current state of the Department's wildlife water development program. This report echoes a number of the concerns and recommendations expressed by other committees, teams, and individuals over the years. However, this report differs in that it takes a comprehensive look at all aspects of the water development program, clearly identifies current issues and challenges, and provides specific recommendations that will be assimilated into a corresponding implementation plan. In addition to presenting these recommendations in a tiered, prioritized approach, the implementation plan, which will follow, will propose process owners, target dates, and performance measures. It is important to note that this report only addresses water developments owned or maintained by the Department. Numerous other wildlife water developments are owned and maintained by the Bureau of Land Management, U.S. Forest Service and the Fish and Wildlife Service.

### **Analysis of The Current Water Development Program**

While pursuing its Charter, the Team quickly recognized specific recurring topics, and their interrelatedness with program strengths and deficiencies. The following is a brief summary of the critical issues that were identified:

1. There is a lack of clearly articulated objectives for the water development program pertaining to: biological vision, construction technology, quality control, information management, priority-based deployment of resources (including volunteers), and long-term maintenance goals.
2. The lack of clear objectives has created misunderstanding among internal and external customers and stakeholders.
3. Roles and responsibilities among Department Branches and Regions as they relate to the water development program, as well as external customers and stakeholders, are not well defined.
4. The Department has capable personnel and an extensive history in the biological evaluation, design, construction, and maintenance of wildlife water developments. Conservation organizations also collectively represent a significant amount of water development experience. Together, these assets represent a valuable suite of knowledge, skills, labor, and equipment by which clearly defined objectives can be realized.
5. The Department has had the opportunity to cooperate with organizations and individuals that have provided hundreds of thousands of dollars and volunteered countless hours of labor, and may be willing to contribute even more to achieve aggressive long-term objectives for the water development program.
6. A comprehensive plan to resolve current wildlife waters maintenance issues in a specified period has not been developed.

7. Adequately addressing the maintenance needs of existing wildlife water developments may require a substantial shift in the prioritization and deployment of Department and volunteer resources (financial and human).

### **Team Recommendations**

To address these issues and others identified in the report, the following summary analysis of the Team's recommendations is presented:

1. Adopt specific Department roles and responsibilities as outlined in this report, to improve efficiency and eliminate unnecessary conflict.
2. Accurately identify and characterize failure-prone, high-maintenance and priority water developments (preliminarily identified in this report). Then, develop an aggressive plan to improve their status in a specified time frame (see Section III).
3. Through a clearly defined prioritization process collaborated by Department personnel and enlisting external stakeholder participation, create a statewide "Water Development Annual Work Plan." This plan will determine the deployment of Department resources and identify opportunities for volunteer support.
4. Water development resources should be focused on the redevelopment of existing priority catchments. Exceptions would be made for new water developments needed for the management of T&E species, re-establishment of species within their historic range or to prevent extirpation of vulnerable populations, or to take advantage of current opportunities, which may be compromised by anticipated changes in land use status. Doing so will result in the deferral of most new catchments, until all priority catchments are redeveloped.
5. Further develop and maintain a comprehensive database of Department wildlife water developments, and take the lead in pursuing a statewide interagency database (currently underway) for all wildlife water developments including springs and tanks.
6. Achieve consensus within the Department on the biological vision, value, and management of wildlife water developments. Consistently involve and communicate this commitment to external stakeholders and land management agencies.
7. Efficiently accept and utilize volunteer labor and financial resources in monitoring, inspecting, and performing maintenance and construction activities on wildlife waters. One option to accomplish this would be the establishment of a volunteer coordinator.

### **Measures of Success**

The Team believes the following measures will clearly evaluate the results of these recommendations:

1. A financially sustainable water development program based on the following defensible, data driven criteria: sound biological assessments, appropriate design, construction and material applications, and efficient resource allocation.
2. All construction and maintenance activities are based on statewide priorities, established through a clearly defined annual planning process (the Annual Work Plan).
3. Prioritization of projects will consider project preferences and seasonal availability of volunteers from stakeholder groups.
4. Resources, regardless of the source, will be focused on redevelopment projects, until major maintenance and water-hauling demands can be diminished to a sustainable level.
5. The Department's Biological Vision for wildlife waters will be reflected in future land management plans and in identifying opportunities for long-range planning of wildlife waters.

## SECTION II. INTRODUCTION

Since assembling the first “Arizona guzzler” in 1946, the Arizona Game and Fish Department (Department) has constructed more than 800 wildlife water developments statewide. The first water developments were designed to support desert quail and upland game bird reintroduction efforts in the 1950s and early 1960s. An evaluation of the water development program in the mid-1960s redirected the Department’s focus from game birds to big game species. The formation of the Arizona Desert Bighorn Sheep Society in 1967 and our joint water development program strengthened this redirection. Since then, the Department’s primary focus has remained on game species, with the exception of a handful of water developments built to specifically benefit non-game species. However, water developments have provided tremendous ancillary benefit to nongame species statewide.

Over the last five decades, water development design, site selection, materials, and construction methods have continued to evolve. This has resulted in an array of catchment types, some functioning well, others not, but all contributing to a growing and currently unsustainable maintenance load. By the 1980s, with enactment of the Sikes Act and many habitat management plans recommending the construction of even more water developments, it became evident that the Department could not adequately track its existing inventory (e.g., catchment location and status). In 1988, the Development Branch began the difficult task of updating location maps and developing a comprehensive database. This effort has been ongoing since, but the long-term viability and effectiveness of the Department’s water development maintenance program remains a challenge.

Throughout the 1990s, a number of committees/teams produced reports evaluating the wildlife water development program. For example, the Deer Waters Committee (1993) concluded that their directive was “too narrow” and expressed concern that the real issue was identifying which wildlife waters needed substantive repair, which required regular water supplementation (water hauling), how to prioritize repairs, and whether a redesign or change in materials was needed. In 1996, the Development Branch Engineering Section evaluated the status and effectiveness of the water development program by interviewing Department employees associated with the water development program. This effort resulted in a report of generalized recommendations regarding biological evaluation, annual work plans, process mapping, roles and responsibilities, partnering, personnel training, standardization of materials, project inspections, life cycle costing, and database management. One year later, in 1997, another committee/team was assigned to evaluate questions being raised as to whether the provision of free-standing water actually benefits wildlife. Their technical review document (“white paper”), which was recently updated, concluded “the preponderance of available scientific evidence indicates that wildlife water developments in the Southwest have not had measured negative impacts on native flora and fauna, and that some wildlife species have benefited from increased availability of free water.” Additionally, it recommended that the Department continue supporting the water development program, and suggested three additional actions:

- An expansion of the water development planning process. This expansion would include doing a better job of assessing potential impacts, benefits, and justification of the need for a specific project.

- Implementation of a statewide monitoring and evaluation program. In particular, there is a need for a strategic review of the balance between expenditures for construction of new water developments and maintenance of existing developments.
- Design and implementation of new research to address outstanding questions concerning the ecological effects of water developments.

### **Current State**

Wildlife waters are some of the more tangible assets the Department oversees in achieving its wildlife management objective. At today's construction costs, the real property value of this resource could conservatively be estimated at \$15 million to \$20 million dollars. Moreover, the Department is at a critical juncture with respect to the long-term viability of these assets. A considerable number of these water developments do not function adequately and require regular water hauling. Water hauling requires a substantial commitment of Department resources, consuming approximately 15% to 20% of Habitat Development and Maintenance crew time, and a corresponding proportion (\$72,500 to \$96,500) of the FW20D (PR) annual budget. Crew time, equipment, and other resources could be better used to repair catchments in disrepair or build new units if hauling requirements were reduced. In extreme drought years, such as 2002, Department resources alone were inadequate to meet water-hauling needs as well as perform necessary maintenance. The demand for hauled water will likely remain high, and most likely increase, if meteorologists' predictions for prolonged drought across the Southwest prove correct. To further complicate this issue, more than 250 water developments are beyond their expected life span, with at least one critical component that needs replacement or is prone to failure.

To prevent adverse impacts to wildlife populations that depend upon water catchments, the Department and its cooperators must adopt a new management plan to achieve objectives that are more aggressive. The timely redevelopment of aging and poorly functioning catchments will be costly and require redirection of Department resources. In essence, it will not be easy. The reader should keep in mind that the current state of the water development program and infrastructure was created over decades. It is a challenge that cannot be resolved overnight. However, the Team believes that the recommendations proposed in this report will move the Department expediently in the right direction and ultimately achieve our desired outcome of long-term sustainability.



### **SECTION III. CURRENT STATUS AND FUTURE MAINTENANCE PROJECTIONS**

**Team Objectives:** Define “Criteria for Success” for wildlife waters built and maintained by the Department. Assess condition and function of Department waters. Project maintenance and redevelopment needs. Develop alternatives to address these needs.

#### **Criteria for Success**

Many current challenges faced by the Water Development Program appear to reflect the lack of clearly articulated objectives for wildlife waters. To address this need, the Team developed “Criteria for Success” to guide the redevelopment of existing waters and construction of new ones. These criteria also were used to assess the performance of existing waters. The Team’s criteria for a “successful” water is one that:

- Has a long lifespan (40-50 years for storage and collection systems, 25 years for drinking troughs).
- Meets clearly articulated biological/species needs.
- Provides year-round, acceptable water quality for wildlife use.
- Maximizes passive design elements, while using proven components applied or installed per manufacturer’s specifications.
- Does not require supplemental hauling except in rare or exceptional circumstances.
- Has minimal visual impacts and blends in with the surrounding landscape.
- Has vehicular access to development or close by, to facilitate routine maintenance and inspections needs (it is understood that many developments will inherently remain remote, i.e., sheep waters).
- Is built with greatest possible time and cost efficiency.
- Requires minimal routine maintenance.
- Is accessible to and used by target species and excludes undesirable/feral species to the greatest extent possible.
- Minimizes risk of animal entrapment and mortality.

#### **Overview of Department Waters**

The Team conducted a preliminary assessment of existing water developments that included field visits to catchments and a comprehensive review of Development Branch records. This assessment included only waters maintained by the Department, and excluded those maintained by other agencies (e.g., Bureau of Land Management, U.S. Forest Service, and Fish and Wildlife

Service). Because of limitations in the data, the conclusions presented here are based on the best available information.

The Department maintains approximately 817 wildlife waters, the majority located in Regions III, IV, and V (Table I.1). These waters were built to benefit a variety of species, including mule deer, white-tailed deer, desert bighorn, elk, wild turkey, pronghorn, quail, doves, and other wildlife. Department waters are of five primary designs: (1) catchment systems that capture, store, and dispense precipitation; (2) modified natural or man-made potholes that collect runoff within ephemeral drainages; (3) storage and drinker systems totally dependent upon hauled water; (4) developed natural springs; and (5) wells powered by windmills or other pumping systems (Table I.1).

The majority of AGFD waters (76%) are catchments, followed by potholes (12%) and developed springs (11%), with the remaining 1% being storage/drinkers and windmills. Catchment systems were generally built for deer, elk, and game birds, whereas potholes were built primarily to benefit desert bighorn.

Table III.1. Wildlife water developments by type and AGFD Region.

Type	Region						Total
	I	II	III	IV	V	VI	
Catchment <sup>1</sup>	15	95	111	174	135	87	617
Dam/pothole <sup>2</sup>	6	1	12	62	16	3	100
Storage + drinker <sup>3</sup>	-	1	-	4	-	-	5
Spring	2	5	32	6	30	11	86
Well/windmill	2	-	2	1	3	1	9
Total	25	102	157	247	184	102	817

<sup>1</sup> Includes a multitude of different designs

<sup>2</sup> Includes natural tanks (tinajas), man-made potholes and drainage dams

<sup>3</sup> Does not capture precipitation, dependent upon hauled water

Catchment-type systems represent the bulk of Department waters and correspond to the greatest operational workload in terms of water hauling and repairs. Catchments have three primary components, a collection system (aprons), storage vessel, and drinking trough. Collection systems can be grouped into five basic designs: (1) concrete aprons, (2) metal aprons on wood frames, (3) metal aprons on metal frames, (4) Fiberglas or butyl aprons on the soil surface, and (5) “natural” aprons that capture runoff from rock surfaces and ephemeral drainages (Photo Set A.1). Usage of these different types of collection systems varies among Regions (Table I.2). Concrete aprons, metal aprons on wood frames, and metal aprons on metal frames are most common, used at 36%, 21%, and 20% of catchments, respectively. A wide variety of storage vessels have been used including buried concrete vaults, above-ground metal ring tanks, rock/masonry potholes, tinajas, adits, above-ground and buried Fiberglas tanks, above-ground and buried welded steel tanks, above-ground PVC tanks, buried PVC pipe, and buried butyl bags. Among these, buried concrete vaults, above-ground metal ring tanks, and rock/masonry potholes are most common, representing 42%, 28%, and 12% of storage systems, respectively (Photo Set A.2). Usage of these different types of storage vessels varies among Regions (Table I.3).



Photo Set A.1. Examples of Collection Systems.

**Top left** – concrete apron (#395)

**Middle** - metal apron/wood frame (#531)

**Bottom left** – metal apron/metal frame (#967)

**Top right** – Fiberglass/asphalt apron (#536)

**Middle right** – collection point on natural slickrock apron (#1029)

**Bottom right** – distance view of natural slickrock apron (#1029)

Table III.2. Collection systems used at AGFD wildlife water developments, by type and Region.  
(Note that many waters have > 1 type of collection system.)

Collection Type	Region						Total
	I	II	III	IV	V	VI	
Concrete apron	10	44	31	67	87	56	<b>295</b>
Metal apron on wood frame	2	18	41	68	27	13	<b>169</b>
Metal apron on metal frame or concrete pillars	3	32	32	63	18	11	<b>159</b>
Fiberglass or butyl apron on ground	-	1	18	11	11	1	<b>42</b>
Natural <sup>1</sup>	1	1	16	20	9	8	<b>55</b>
<b>Total</b>	<b>16</b>	<b>96</b>	<b>138</b>	<b>229</b>	<b>152</b>	<b>89</b>	<b>719</b>

<sup>1</sup> Capture runoff from slickrock and surface or subsurface flow in ephemeral drainages



**Photo Set A.2. Examples of storage systems.**

**Top left** – concrete vault (#416)

**Bottom left** – ring tank with cover that serves as secondary collection apron (#542)

**Top right** – pothole with shade cover (#357), gabion in foreground



Table III.3. Storage systems used at AGFD wildlife water developments by type and Region.  
(Note that many waters have >1 type of storage system.)

Storage Type	Region						Total
	I	II	III	IV	V	VI	
Concrete vault (buried)	10	58	37	83	87	60	<b>335</b>
Metal ring tank (above ground)	2	28	44	96	34	16	<b>220</b>
Fiberglas tank (above ground)	-	4	27	21	13	8	<b>73</b>
Fiberglas tank (buried)	-	1	6	2	1	1	<b>11</b>
Fiberglas tank (Xerxes)	-	-	1	12	-	-	<b>13</b>
Welded steel tank (above ground)	1	2	3	14	1	1	<b>22</b>
Welded steel tank (buried)	-	-	-	-	15	-	<b>15</b>
PVC tank (above ground)	-	1	-	-	-	-	<b>1</b>
PVC tubes (buried)	-	1	-	4	-	-	<b>5</b>
Butyl bag	-	2	2	-	2	-	<b>6</b>
Rock/masonry	6	-	15	57	14	2	<b>94</b>
<b>Total</b>	<b>19</b>	<b>97</b>	<b>135</b>	<b>289</b>	<b>167</b>	<b>88</b>	<b>795</b>

### **Condition and Function of Waters**

The Team's assessment focused on catchments, which represent the bulk of Department waters and have major components subject to degradation, impaired function, and eventual failure. In contrast, potholes are characteristically simple masonry structures (dams) that are more resistant to the elements and usually require much less maintenance other than silt removal and water hauling. However, due to their typically remote locations, maintenance and water hauling to potholes are usually much more expensive. Other types of waters (storage and drinker systems, springs, and wells) are important to wildlife, but represent a relatively small fraction of the operational workload faced by the Department. A water-by-water evaluation of catchment function and condition was beyond the scope of the Team's charter and time allocation, thus our assessment utilized existing information, including: catchment age, construction type, and water-hauling requirements. The assessment presented here is intended to serve as a preliminary analysis that should be followed up by a more detailed evaluation on a catchment-by-catchment basis.

***Catchment Age*** – Age is a useful overall measure of catchment condition, being correlated with the expected life span of major components. Approximately 50% of AGFD catchments are >30 years old, placing them beyond a reasonable service life. Statewide, average catchment age is 34 years (Table I.4). Catchment age varies among Regions, with an average of 27 years in Region

III and 34-40 years in Regions I, II, IV, V, and VI (Note: ages reflect original date of construction and do not include subsequent modifications or redevelopment).

Table III.4. Age of catchment-type water developments by AGFD Region.

Region	Number of Catchments by Age						Average
	<5	6-10	11-20	21-30	31-40	>40	
I	-	1	3	-	-	11	36
II	1	1	21	7	27	34	34
III	6	11	23	10	39	19	27
IV	1	13	33	1	44	77	34
V	4	-	29	4	22	67	37
VI	3	6	7	2	12	55	40
All Regions	15	32	116	24	144	263	34

**Water-Hauling Requirements** – The need for supplemental (hailed) water is a useful measure of catchment function. Water hauling typically is required when catchment components malfunction, original designs are inadequate, wildlife water demands exceed capacity, or because of persistent drought. A current example illustrating all three factors occurred spring-summer 2002 in Unit 9. Old and often poorly functioning apron catchments in Unit 9, originally constructed for mule deer, were inadequate to support elk populations that have dramatically extended their ranges since these waters were built (Photo A.3). Similar examples exist in desert habitats. Concrete vault catchments built in the 1950s-1960s for game bird restoration also have inadequate capacity to support the current demands of desert mule deer.

The Team compiled and reviewed Development Branch water hauling records from 1996 through 2001, a period including years of average, above average (1998), and well below average (1996) precipitation. It is important to note that these data likely underestimate the actual amount of water required to keep catchments from going dry. Development Branch does the majority of water hauling; however, “water buffalo” deliveries by Wildlife Managers and hauling by non-Department personnel (e.g., volunteer efforts in Region 4 and in Unit 9) are not entirely captured in Development Branch records. Typically, water is hauled only to catchments identified and scheduled by Wildlife Managers or Development Branch personnel. In severe drought, each Region has identified critical catchments that receive priority monitoring and hauling. However, criteria for this designation have not been standardized statewide and are in part responsible for variations for water hauled in different regions.

AGFD water-hauling efforts are directed primarily to catchment systems, which received 98% of all water deliveries from 1996-2001 (Photo Set A.4). Hauling to remote potholes often can be done only by helicopter, at conservatively four times the cost of hauling by truck (Photo Set A.4).



**Photo Set A.3. Examples of Older Developments**

**Above** 1960s vintage apron catchment in Unit 9 (#256). The water catchment is still functional, but has insufficient storage capacity to support elk densities that have increased dramatically since the catchment was built. Many similar catchments in Unit 9 are failing because of component failures and ongoing drought. Near-heroic hauling efforts by Department employees and volunteers were required to keep these waters from going dry during Spring-Summer 2002.



Water hauling varied considerably among years (Table I.5). Total water hauling was lowest in the relatively wet El Niño year of 1998, and highest in the drought year 1996 (2002 set a new record, with a total of 1.9 million gallons hauled). From 1996-2001, 331 of 617 Department catchments (54%) received hauled water at least once. On average, the Department hauled approximately 600,000 gallons each year to 154 (25%) of its catchments at an average cost of \$144,000 per year. Water hauling varied greatly among Regions (Table I.6). Region IV had the highest percentage of catchments requiring hauled water (42%). Region III consistently showed lower levels of water hauling, reflecting less utilization by mule deer and elk as well as the availability of alternative water sources. In addition, many bighorn sheep catchments in Region III have been redeveloped to minimize water hauling. Water hauling also varied among Game Management Units. For the six-year period 1996-2001, Units 41 and 9 had far greater amounts of water hauling than did other Units (Table I.7).

**Photo Set A.4. Hauling water.**

**Top** – water delivery to truck-accessible apron catchment.

**Bottom** – helicopter dropping water in pothole.

Table III.5. Water hauled by AGFD Development Branch to AGFD catchments 1996-2001.

(Does not include hauling by Wildlife Managers and non-Department personnel)

Year	No. Deliveries	No. Gallons
1996	553	1,417,900
1997	220	486,000
1998	97	189,850
1999	228	428,250
2000	390	686,200
2001	209	372,250
6-Year Average	283	605,742

Table III.6. AGFD Development Branch water hauling to AGFD catchments by Region 1996-2001

Data are number of catchments and percent of catchments receiving hauled water (minimum, maximum, and 6-year average). Does not include hauling by Wildlife Managers and non-Department personnel.

Region	No. Catchments <sup>1</sup>	Minimum (%)	Maximum (%)	6-Year Average (%)
I	15	7	53	27
II	95	16	42	29
III	111	<1	17	6
IV	174	18	66	42
V	135	<1	43	24
VI	87	7	34	17

<sup>1</sup> Excludes potholes and other types of waters not dependent on natural precipitation

Table III.7. AGFD Development Branch water hauling to AGFD catchments by Game Management Unit, six-year average 1996-2001.

(Current cost for truck hauling is approximately \$240 per 1,000 gallons. Average cost per year is \$144,000.)

Unit	Amt (gal)	Unit	Amt (gal)	Unit	Amt (gal)	Unit	Amt (gal)	Unit	Amt (gal)
3B	7,200	15A	7,350	22	11,210	34B	3,600	40B	24,242
4A	7,900	15C	7,500	24A	3,667	35B	6,775	41	125,075
4B	18,600	15D	3,600	28	16,713	36A	4,800	42	25,083
5B	9,520	16A	18,433	29	1,500	36B	1,2800	43A	24,000
6A	1,500	17A	3,000	30B	1,833	37A	32,200	43B	15,071
7	17,980	19A	6,000	31	3,000	37B	16,310	44A	36,325
9	98,867	20B	3,000	32	5,800	39	33,617	44B	31,600
13A	2,250	20B-E	4,533	34A	3,200	40A	39,267	45A	15,180
13B	1,500	21	16,950						



### **Maintenance Projections**

The Team focused on catchment collection and storage systems, which are the most expensive components to replace in the event of failure. Major repairs done by Development Branch from 1992-2001 are summarized in Table I.8. Repairs to tanks and replacement of aprons, tank liners, and above-ground tanks were most common. Approximately six catchments per year have been redeveloped (replacement of most/all major components). A substantial amount of needed repair/redevelopment work has been identified (Table I.8); however, it is important to note that the list of “pending” projects reflects only a two to three-year work plan based on typical Special Tag and Development Branch funding.

Table III.8. Completed and pending repairs to AGFD catchments, 1992-2001.  
Number done, number pending, and cost per unit are based on data through November 2002.  
Costs do not include donated labor and materials.

Type	No. Done	No. Pending	Cost Per Unit (\$)
Replace tank liner	39	15	2,500
Repair storage tank	29	1	800-2,500
Replace entire apron	20	18	4,000-8,000
Replace apron roof	9	8	4,500
Replace above-ground tank	17	9	3,500-8,000

The majority of Department catchments are beyond or rapidly approaching their anticipated life span. Given the large number of waters, the Department will have to adopt an aggressive approach to catchment redevelopment. The Team used existing data from the Development Branch waters database to preliminarily project and prioritize redevelopment needs. First-priority catchments are those that have required excessive water hauling and may have failure-prone collection and or storage systems. Excessive hauling was defined as receiving  $\geq 2$  loads/year in years when supplemental water was needed (based upon 1996-2001 hauling data). System components of primary concern are metal aprons on wood frames, Fiberglas/asphalt and butyl aprons on the ground surface, and metal ring tanks. These types of aprons are aging (generally  $>30$  years old), particularly vulnerable to degradation by the elements, and subject to sudden failure (Photo Set A.5). Metal ring tanks are of concern because of the high frequency of liner failures. Seventy-seven first-priority catchments were identified. Most were in Regions IV (36) and II (25) (Appendix I.1). Second-priority catchments are those that did not require excessive hauling, but have failure-prone aprons **and** metal ring tanks. There are 125 catchments in this category. The majority are in Regions IV (43), III (35), and V (25) (Appendix I.1). Finally, third-priority catchments are those that did not require excessive hauling, but have failure-prone aprons **or** metal ring tanks. There are 72 catchments in this category. Most are in Region IV (24) (Appendix I.1). Base on a ten-year redevelopment schedule, costs are estimated from \$2.9 million to redevelop just first priority catchments to \$4.5 million for all first, second and third priority catchments.



**Photo Set A.5. Examples of Failure-Prone Catchment Aprons.**

**Left** – metal apron on wood frame (#260). **Right** – remnants of Fiberglass/asphalt apron before replacement (#545).

For example, some catchments may have been redeveloped but the modifications were not reflected in the database. On-the-ground verification of the data will be necessary to develop a more accurate priority list. In addition, the Team's assessment did not include other key factors that must be considered when prioritizing catchments for redevelopment. These factors include: biological importance of the water, condition of catchment components, site-specific factors affecting redevelopment options, accessibility for redevelopment, public access, political climate and land management status in the surrounding area. A critical next step in planning redevelopments is to obtain site-specific information, beginning with catchments on the priority list. Ultimately, this evaluation should include all Department waters. To assist in the evaluation process, the Team developed a scoring system that, with ongoing refinement, could be used to prioritize waters for redevelopment (Appendix I.2). This site-specific evaluation process may also identify waters that are not cost-effective to maintain.

**Number of Waters That Can Be Sustained**

The Team charter included an objective to determine the maximum number of waters that could be sustained by the Department under current resource allocations. Determining this number is an extremely complex process, because of the many management decisions involved and numerous options for building and maintaining waters. Given the recommendations in this report, the team determined that current resource allocations are not an optimal basis for future decision-making. Ultimately, the number of supportable waters will depend upon the period allotted to upgrade existing waters, adjustments to internal resource allocation, availability, and utilization of external resources, and expected life span (materials and technology) of redeveloped waters. Adopting the design recommendations presented in this report (Section XII) will increase the number of water developments that the Department can support. For example, it might be reasonable to maintain 800 water developments in good working order if 16 redevelopment projects are completed each year and each project extends the life span to 50 years. The number of projects accomplished each year and expected life spans may

vary, but this principle should be applied whenever decisions are made regarding construction or redevelopment of waters.

### **Assumptions Made In Developing Potential Approaches To Achieve Sustainability**

The Team developed three potential approaches to illustrate how priorities might be shifted to achieve a sustainable maintenance status for wildlife waters over 5-10 year periods. Given the complexity involved, these alternatives and associated cost estimates should only be considered starting points for developing approaches that are more detailed. Labor costs are not included because of numerous unknown variables concerning allocation of Department personnel, and potential use of outside contractors and volunteers. Cost estimates do not reflect inflation. These alternatives reflect the following assumptions:

- Redevelopment efforts focus on waters listed in this report (Appendix I.1), including 76 first-priority waters (approximately 24 are in elk habitat in Unit 9 and elsewhere), 126 second-priority waters, and 72 third-priority waters.
- Waters are redeveloped using designs that meet our proposed Criteria for Success.
- Department continues “inexpensive” maintenance (materials cost <\$2,000) to keep priority catchments functioning until they can be fully redeveloped.
- Department personnel in Regions II and IV contribute to the redevelopment of waters.
- Volunteers are used extensively for catchment evaluation and construction work.
- External contractors are utilized to complete NEPA paperwork. Costs of these services are not included, but could be minimized by utilizing a single consulting firm to do NEPA for all projects within a geographical area over a specified project time frame.
- Department State Trust Fund Grant budget allocations for wildlife waters are maintained or increased.
- Additional funding is obtained through Special Tag Funds, volunteer efforts, and other sources. This would facilitate the potential use of contractors for catchment redevelopment.
- Material cost is conservatively estimated at \$15,000/project for deer, pronghorn, bighorn waters; \$27,000/project for elk waters (due to greater storage requirements).
- Redevelopment projects will assure a more efficient allocation of human resources and equipment (e.g., multiple projects in same general vicinity are done simultaneously).

### **Potential Approaches That Would Will Achieve Sustainability**

***Approach 1 – Minimal Reallocation of Existing Resources and Acquisition of Supplemental Funding:*** Development Branch will implement **12** projects and Region IV will complete **3 per year**. We estimate that this would result in **15** re-development projects completed annually, over the next five years. Bighorn sheep projects would comprise four to six of these redevelopment projects per year. Consequently, 9-11 projects targeting elk, deer, or pronghorn would be completed each year. **Under this scenario, within five years approximately 93% of the first-priority** projects would be completed. Estimated cost for materials: \$1,413,000 (24 elk, 51 deer, pronghorn, or bighorn waters). Within 10 years, **all first-priority, 72% of the second-priority, and 0% of third-priority** projects would be completed. An additional \$1,485,000 will be required for the second phase of implementation.

***Approach 2 – Moderate Reallocation of Existing Resources and Acquisition of Supplemental Funding:*** Requires significant reallocation of Development Branch and Regional resources to increase the number of redevelopments to **20 to 21 per year**. Department personnel in Regions II and IV are reassigned to participate in the construction of redevelopment projects. Regional manpower commitment would entail selecting a Wildlife Specialist to serve as general project manager, supervise implementation of each project, and supervise the use of volunteers. Implementation of each redevelopment project will require a minimum of four Regional personnel for up to four days. Additional allocation of resources (Tag Funds and other sources) will be required to enhance the completion of NEPA compliance documents. Contracting environmental consultants will be required to accelerate the completion of NEPA documentation. Development Branch will make use of volunteers on all projects, to the maximum extent possible. The Regions would have to complete as many as **5** additional projects per year. Other projects could be completed through contracting outside services if volunteer labor is unavailable or unsuitable for the project. Reallocation of work force priorities will be required within Development and the Regions. If implemented, **all first-priority** redevelopments can be accomplished within **four** years. After 10 years, **all first and second priority projects but no third-priority** projects will be completed. Estimated cost for materials: \$1,818,000 over five years and an additional \$1,575,000 for the second five-year phase.

***Approach3 – Significant Reallocation of Existing Resources and Acquisition of Supplemental Funding:*** Requires significant reallocation of Development Branch and Regional resources to increase the number of redevelopments to **27-28 per year**. Department personnel in Regions II and IV are reassigned to participate in the construction of redevelopment projects. Regional manpower commitment would entail selecting a Wildlife Specialist to serve as general project manager, supervise implementation of each project and supervise the use of volunteers. Implementation of each redevelopment project will require a minimum of four Regional personnel for up to four days. Contracting environmental consultants or possibly creating a limited internal position within the Habitat Branch will be required to accelerate the completion of NEPA documentation. Tag Funds could be used to contract environmental consultants to prepare NEPA documentation and facilitate the process on large groups of catchments or

geographical tracts. Development Branch will make use of volunteers on all projects, to the maximum extent possible. The Regions would have to complete as many as **12** projects per year. Other projects could be completed through contracting outside services if volunteer labor is unavailable or unsuitable for the project. If implemented, **all first-priority** redevelopments can be accomplished within **three** years. After 10 years, **all first-, second-, and third-priority** projects will be completed. Estimated cost for materials: \$2,373,000 over 5 years and an additional \$2,100,000 for the second five-year phase.

### **Recommendations**

The Department is at a critical juncture with respect to water catchment operation and maintenance. A significant number of AGFD catchments do not function adequately and require regular water hauling. Water hauling is a major burden on Department resources. It consumes approximately 15% to 20% of Habitat Development and Maintenance crew time, and severely affects the heavy equipment maintenance budget as water truck maintenance and repairs, which can be extensive during drought years, are charged to this funding. In extreme years (such as 2002), Department resources have been inadequate to meet water-hauling needs. Demand for hauled water will remain high or perhaps increase if climatic predictions for prolonged drought across the Southwest prove to be correct. Water hauling is not a viable long-term strategy to address catchments that do not function properly or that have failure-prone components. Many existing catchments are beyond their reasonable service life or have critical components that are in need of repair or prone to failure. A relatively small proportion (approximately 10%) of aging AGFD catchments have been redeveloped to date. Proactive measures are essential for the timely redevelopment of aging and poorly functioning catchments, and to prevent adverse impacts to wildlife populations that depend upon these waters. The Team recommends implementing the most aggressive approach attainable, noting this will rely on considerable supplemental funding, yet to be identified. However, regardless of the scope of work pursued, the following recommendations are essential:

- Water development resources should be focused on the redevelopment of existing priority catchments. Exceptions would be made for new water developments needed for the management of T&E species, re-establishment of species within their historic range, or to prevent extirpation of vulnerable populations. Doing so will result in the deferral of most new catchments, until all priority catchments are redeveloped.
- Redirect Department resources (staff and funds) toward the redevelopment of existing catchments, emphasizing long-term solutions rather than short-term “band-aids.”
- Conduct on-site evaluations of priority catchments listed in Appendix I.1. This evaluation should eventually be extended to all Department waters. Use a refined version of the proposed scoring system (Appendix I.2) to evaluate development condition, function, biological need, and other important decision variables. Responsibility for the evaluation falls predominantly on the Regions, but should

include consultation with Development Branch as well as pertinent external stakeholders.

- Prioritize catchments needing repair and redevelopment through the proposed Annual Work Plan process (Section V, Planning). Consider options to remove or abandon non-priority waters that do not provide substantial benefits to wildlife or that cannot be redeveloped in a manner that meets Criteria for Success. (Note: Some waters may not be candidates for abandonment due to their original funding criteria and capitalized asset status).
- Design new and redevelop existing waters in a manner that meets current and/or forecasted biological needs, increases longevity, reduces maintenance requirements, and reduces or eliminates the need for water hauling (Section VII, Water Development Construction).

## **SECTION IV. DEPARTMENT ROLES AND RESPONSIBILITIES**

***Team Objective:*** Evaluate current roles and define responsibilities of various Department work unit activities related to wildlife water developments.

### **Issues**

Currently, roles and responsibilities of Department work units in water development-related activities are not well defined. Clarification of these roles would increase efficiency, minimize unnecessary conflict, and prevent duplication of efforts.

### **Recommendations**

The Team recommends that responsibilities for waters-related activities be assigned as follows:

#### ***Regional Offices***

1. Collect and archive field data on water levels, depletion rates, evaporation rates, and condition of water developments, maintenance needs, and wildlife use. Analyze data to determine dry dates and hauling needs. Transfer this information to appropriate Regional and Development Branch personnel. (See Section X – Water Monitoring).
2. Complete and submit proper documentation in a timely manner to initiate water hauling and catchment maintenance by Development Branch.
3. Perform minor maintenance at water catchments (e.g., float valve adjustment or replacement, painting components, repairing fence, sealing small leaks, mucking out drinkers).
4. Develop and maintain a prioritized list of Regional water developments requiring maintenance or redevelopment, or in some cases abandonment.
5. Participate in the proposed Water Development Annual Work Plan meeting. Develop and submit Regional section of Annual Work Plan, participate in statewide project prioritization process.
6. Identify a lead person(s) who will oversee coordination with volunteer organizations at the Regional level.
7. Determine biological need for all proposed new waters and waters requiring redevelopment.
8. Verify location, assess function, condition, and biological importance of existing water catchments.

9. Communicate the Department plans regarding water developments with appropriate land management agencies, Habitat Partnership Committees (HPCs), stakeholders, and internal/external customers.
10. Serve as the primary contact for external customers with questions regarding site selection and redevelopment priority ranking.
11. Provide comment on land management planning documents affecting water development construction, maintenance, water hauling, monitoring, and coordination.
12. Solicit and submit Special Tag proposals for redevelopment of wildlife waters in accordance with the Annual Work Plan (See Section V – Planning).
13. Coordinate volunteers or contractors to haul water to dry or low catchments when Development personnel are unable to do so. Water-hauling data should be compiled and provided to the Development Branch for inclusion in the waters database.
14. To the extent possible, provide technical support and assist Development Branch in preparation of environmental compliance documents for development or redevelopment of wildlife waters.
15. Review technical specifications of proposed projects.
16. Assist in the supervision of volunteers and/or contractors working on wildlife waters in coordination with Development Branch.
17. Maintain, repair, or install identification signs at Department waters.

***Development Branch***

1. Allocate federal, state, and other resources among prioritized wildlife water developments and other projects. Accurately track and manage project budgets to determine operational costs and achieve Annual Work Plan objectives.
2. Provide technical expertise on the siting, construction, and engineering of wildlife waters.
3. Maintain a current, comprehensive database on Department water catchments. Work toward the development of a standardized database incorporating waters managed by other government agencies.
4. In most cases, provide staff and materials necessary for construction, redevelopment, and maintenance of prioritized wildlife waters.
5. Take the lead in coordinating with volunteers and other agencies as necessary to facilitate the construction or redevelopment of wildlife waters.



6. Install signs on new, maintained, or redeveloped waters. Provide Regions with replacement signs as needed.
7. Serve as a secondary archive and repository for environmental compliance documents (Habitat Branch serving as the primary source). Serve as the primary source for historical maintenance and catchment feature information on Department waters.
8. Maintain a current, prioritized list of water developments requiring maintenance or redevelopment; communicate this information as needed to internal and external customers.
9. Assure timely completion and adequacy of environmental compliance documentation for development and redevelopment of wildlife waters.
10. Haul water to catchments as needed. Coordinate hauling by contractors and non-Department personnel as needed.
11. Supervise staff, volunteers, and contractors working on wildlife waters.
12. Solicit and submit funding proposals in coordination with the Regions to support the construction, redevelopment, and maintenance of wildlife waters that meet Annual Work Plan objectives and ensure that projects meet Criteria for Success (Section III.1, Criteria for Success).
13. Complete mandatory reporting documents (internal/external) in a timely manner.
14. Contract vendors and complete procurement documents required to complete water developments.
15. Serve as a primary contact for information on water catchment construction techniques and scheduling. Direct biological, site selection or project priority questions to the appropriate work unit.
16. Organize the Annual Work Plan meeting. Participate in drafting of the statewide Work Plan. Provide technical assistance as requested at Regional level to develop project proposals.

***Game Branch***

1. Provide species-specific expertise to ensure that new and redeveloped catchments meet clearly articulated biological objectives.
2. Assist Regions with grant proposals for the development or redevelopment of wildlife waters benefiting game species.
3. Coordinate and administer the Special Tag Fund process, including budget tracking, providing budget information to external customers, organizing stakeholder meetings

and assuring water related project proposals are tiered to Annual Work Plan priorities..

4. Assist in developing and communicating the “biological vision” for wildlife waters to internal/external customers (Section VI, Customer Relationships).
5. Participate in drafting statewide Annual Work Plan for wildlife waters.
6. Serve as a primary contact for external customers with questions on water-related efforts related to game species.
7. Actively facilitate communication and cooperation between the Branches, Regional offices, and other external customers in the development of Special Tag Fund projects.

### ***Research and Nongame Branches***

1. Review the draft Annual Work Plan and provide expertise on biological issues pertaining to wildlife waters.
2. Conduct inventory, research, and monitoring projects that evaluate the biological basis of the Department’s wildlife water development program. Provide and support outreach opportunities resulting from these efforts.
3. Research Branch must take the lead in developing a “biological vision” for wildlife waters. Communicate that information to internal/external customers (Section VI, Customer Relationships).

### ***Habitat Branch***

1. Assist Regions and Development Branch with GIS needs and mapping of water catchments statewide.
2. Review, formalize, and track environmental compliance documents for water projects. Serve as the primary archive for these documents.
3. Monitor and create staff awareness of potential and actual T&E species issues related to water development activities.
4. Interact with other agencies when appropriate to facilitate long-term commitments to wildlife waters maintenance.
5. Consider and incorporate biological and operational issues related to wildlife waters when reviewing land management plans and participating in interagency planning efforts.

## SECTION V. PLANNING

**Team Objective:** Evaluate the Department's approach to planning and prioritizing water development projects (redevelopment and new construction). Identify opportunities to increase efficiency, work more effectively with internal customers, and reach consensus internally on resource allocation for wildlife waters. Develop recommendations and process improvements to capitalize on these opportunities.

### **Issues**

1. The planning and prioritization process for the construction and redevelopment of wildlife waters has sometimes been based on short-term objectives. This approach can result in decreased efficiency and often unplanned allocation of resources, rather than progressing toward long-term program objectives and biological need.
2. A formal process is needed to equitably prioritize water development activities statewide and to identify and allocate available resources.
3. In some cases, the Department has not adequately addressed biological and technical aspects of water development planning (e.g., site selection, design, etc.). This approach is not conducive to meeting the "Criteria for Success."

### **Recommendations**

1. Develop and implement a statewide Annual Work Plan process, prioritizing all water-related projects for the upcoming fiscal year and identifying potential projects for following years. Each Region would prepare its respective section of the plan, with technical support from Development Branch and other work units as needed. The plan would include:
  - A critical path flow chart that comprehensively describes the overall project delivery process from conception to construction.
  - A prioritized list of catchments for redevelopment, founded primarily on information presented in this report (Appendix I.1) and from on-site evaluations using the proposed scoring process. (See Appendix I.2).
  - A brief description of each project, with approximate costs, design type, required environmental compliance documents, opportunities for volunteer participation, and schedule for completion. The plan must be flexible to allow for modifications as needed.
  - A review of the previous year's objectives and accomplishments.
  - The target deadlines for the work plan must be congruent with the Special Tag Fund project submittal process. A recommended schedule follows:

*September*

Regions submit a prioritized list of candidate projects based on criteria established through a common scoring mechanism (See Appendix I.2).

*October*

Development Branch, Game Branch, and Regional representatives meet to determine priorities, identify volunteer needs/opportunities, assess previous year's performance, and develop preliminary work schedule.

*December*

Annual work plan completed and distributed to internal and external customers (conservation organizations, HPC members, etc.) for use in developing funding proposals, and communicating volunteer needs/opportunities.

*March-April*

Evaluate Special Tag Fund proposals with regard to work plan priorities and Criteria for Success.

*May*

Finalize work plan and schedule based on proposal success. Host an annual volunteer/stakeholder summit to discuss Annual Work Plan and other volunteer needs/opportunities.

2. The Department must assume lead responsibility in establishing the biological, technical, and prioritization criteria for wildlife water development maintenance and redevelopment throughout the Annual Work Plan process.

## **SECTION VI. RESOURCE ALLOCATION AND FUNDING**

### **VI.1 STATE TRUST FUND GRANT FW20D (Habitat Enhancement and Facilities Development, Operations and Maintenance)**

**Team Objective:** Analyze available FW20D project funding to determine if it can be utilized more effectively to benefit wildlife water development.

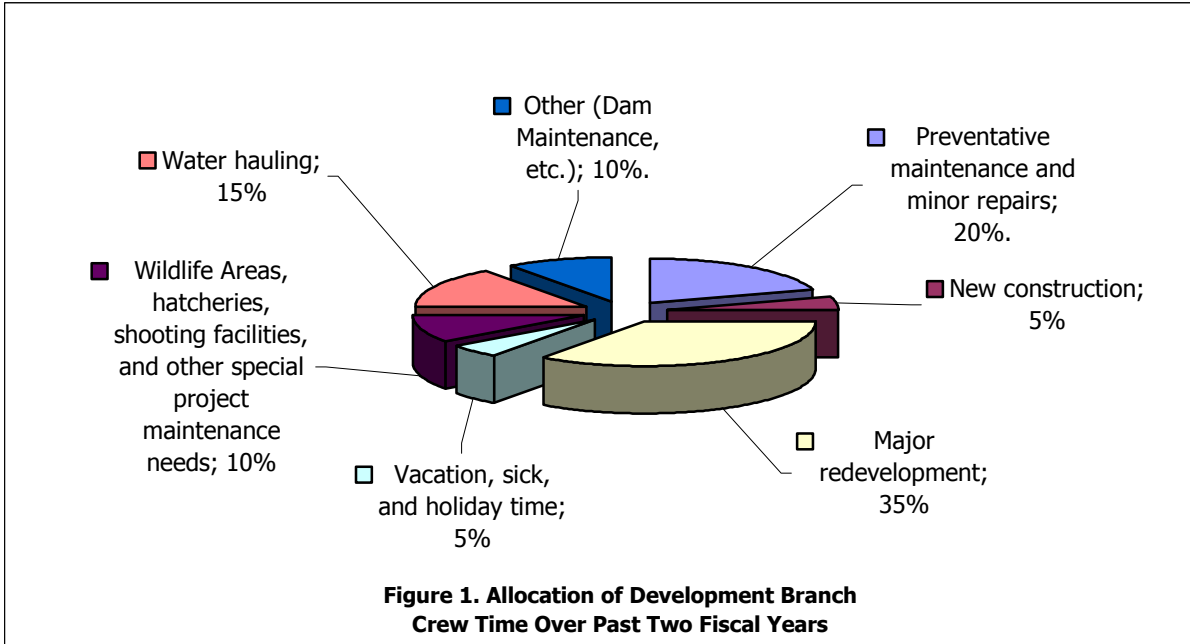
#### **Issues**

1. Although the amount varies from year to year, slightly less than 50% of the project budget is game species (PR) eligible, the remainder is allocated to sport fish projects (DJ).
2. PR Budgets have declined over the last three years. Factors include allocation for indirect cost recovery, a substantial market adjustment for Wildlife Series salaries, PIPP and under funded wildlife areas.
3. The majority of PR habitat improvement funds are committed to PS/ERE (labor and expenses). Very little of these funds are available for construction materials or contracting.
4. Major project redevelopments are highly dependent on Special Tag Fund monies.
5. Approximately 55% to 60% of Development Branch crew time is allocated toward water development maintenance, redevelopment, or new construction. The remainder is committed to other maintenance and construction obligations, particularly on the Sportfish (DJ) component of the FW20D project (See Chart VI.1).
6. Department land acquisitions continue to add a significant and growing maintenance obligation to the project in personal services and operating funds, reducing the time and dollars that can be spent on wildlife waters.
7. A formalized process does not exist for determining maintenance priorities for a given fiscal year.
8. Dam maintenance needs are becoming more critical and compete for Development Branch crew time.

#### **Recommendations**

1. Be prepared to take advantage of any increase in PR appropriations, by developing a list of potential cash and in-kind matches.
2. Evaluate other methods of achieving Development Branch maintenance obligations not associated with wildlife waters, specifically contracting outside services.
3. Deploy Department and volunteer resources based upon Annual Work Plan (Section V - Planning).

4. All new land acquisitions should identify a funding source for long-term maintenance needs.
5. If funding for water development maintenance requirements becomes more critical, other project budgets may need to be re-evaluated to direct more PR dollars into FW20D.



## VI.2 SPECIAL TAG FUND

**Team Objective:** Evaluate the Special Tag Fund process, including internal/external coordination, and enforcement of contractual obligations/agreements. Develop recommendations for improvement.

### Overview of Special Tag Fund Process

The Special Tag Fund is supported by big game hunt permits (elk, bighorn sheep, deer, pronghorn, javelina), which are transferred to nonprofit conservation organizations by the Commission and raffled or auctioned off to the highest bidder. Before mid-December, the Game Branch distributes a project solicitation memo. Traditionally, the memo has been distributed to the Regional Supervisors, Game Branch, Partnership Committees, and others. The memo briefly describes the application process and identifies types of projects that will receive priority consideration. Typical applicants are Department Wildlife Managers and Program Managers, resource managers from other agencies, conservation organizations, landowners, and Habitat Partnership Committees (HPCs). Department staff and external customers typically meet before the submission deadline to discuss and/or draft potential proposals. External proposals are typically submitted through the appropriate Wildlife Manager or HPC. Development Branch reviews most proposals for the construction or redevelopment of wildlife waters. However, the Development Branch has not reviewed many cooperative projects (between land management agencies, landowners and the Department) in the past.

Proposals may be submitted at any time; however, the annual deadline is early March. Shortly after the deadline, proposals are grouped by species and project type. Proposals are circulated to the appropriate conservation group, Department Branch or Region for review and prioritization, and then returned to Game Branch. Successful applicants are usually notified by August. Once successful proposals are determined, an agreement between the conservation organization auctioning the tag and Department is signed. The conservation group then transfers the money to the Department (Game Branch), who allocates approved funds to the appropriate PCA code. Currently, there are 18 Game Branch PCAs categorized by species and conservation organizations. Once funded, most projects are completed within one year, although reliance on land management agencies for environmental compliance documentation can cause substantial delays.

Game Branch monitors status and expenditures of all Special Tag Fund projects pertaining to game surveys, habitat modification, and wildlife translocations. Development Branch manages and monitors projects related to water development projects and regularly reports to Game Branch.

### **Issues**

1. Special Tag Fund proposals for water development-related projects are not currently tiered to an overall Department work plan.
2. Special Tag Fund accounting and reporting must be administered in a timelier manner to support conservation groups in their annual evaluation of proposals.
3. Management of interest accrued from Special Tag Funds is not well defined.
4. Communication and process coordination among internal (Regions, Wildlife Managers, Development Branch) and external customers (conservation organizations government agencies, HPC) needs improvement.
5. Project prioritization is not based on established long-term objectives.
6. External proposals often lack adequate project description and design.
7. Accountability for project management and fund administration is unclear or sometimes lacking.
8. Turnover of Wildlife Managers and other Regional personnel creates difficulties in monitoring projects.
9. Although a requirement for all proposals, EA checklists are rarely completed and submitted with proposals.

### **Recommendations**

1. The Special Tag Fund administration (i.e., proposal submissions, review and selection) for water-related projects should be initiated at the completion of the Annual Work Plan process for that year.
2. Water-related proposals must clearly be tiered to Annual Work Plan priorities through eligibility windows established to facilitate the submittal process.
3. Create a checklist, similar to EA checklist used by the Habitat Branch, to ensure that proposal requirements are completed before project submittal acceptance. Game Branch should be responsible to ensure checklist compliance.
4. Arrange annual project site visits to review completed projects with members of participating conservation groups and provide annual completion reports to board members.

### **VI.3 DONATIONS**

**Team Objective:** Evaluate current and potential role of donations from private citizens, conservation organizations, and businesses dedicated to wildlife water developments.

#### **Issues**

1. During times of drought or other crises, external customers often donate money to the Department on behalf of wildlife.
2. Customers expect their donations to be quickly and wisely used to benefit wildlife.
3. Donations should be accurately accounted for and managed separately from other funding sources.
4. Private donations can be used to match federal dollars.
5. There may be opportunity for conservation organizations to fund directly various vendor-supplied materials and services associated with a project.

### **Recommendations**

1. Continually seek private donations and by increasing outreach presentations, marketing specific projects, distributing brochures, and through other Department communications (e.g., newsletters, TV shows, magazine articles).
2. Consider identifying a Department employee to act as a donation coordinator for wildlife waters.
3. Send a thank you letter and informational update to all donors. Donors of large sums should be thanked by the Director or recognized in a public forum.



4. When advantageous, donations should be managed by Wildlife for Tomorrow, to accelerate their use for water development related procurements.
5. Utilize new or existing appropriate PCA codes for donations.
6. Evaluate opportunities for direct purchase by conservation organizations of materials and/or services for projects as part of the Annual Work Plan process.

## **VI.4 OUTSOURCING**

**Team Objective:** Evaluate costs and benefits of outsourcing the preparation of environmental compliance documentation, construction and renovation of wildlife waters.

### **Issues**

The Department and other State agencies commonly use outside contractors/vendors to perform services or provide materials. Currently, the Regions and Development Branch use outside contractors for wildlife waters on a very limited basis.

#### **Potential advantages of utilizing outside vendors/contractors:**

- Allows Development Branch staff to focus efforts on specialized or priority projects. NEPA compliance consumes excessive staff time and causes substantial delays in project completion.
- Increases the total number of water catchments built, redeveloped, and repaired annually (assuming additional funding is available).
- Provides a new “tool” for responding quickly to emergency repairs, without affecting other scheduled projects.
- New technological approaches and expertise to project design.
- Supports small businesses.

#### **Potential risks or challenges to using an outside vendor for water developments:**

- Contracting may be more expensive than in-house labor, but may be necessary to meet aggressive work plans.
- Staff time may need to be reallocated to develop construction documents, writing contracts and specifications, contract administration, providing information, and inspecting contractor project sites.
- It may be difficult to find contractors interested in or capable of building water developments at remote locations and unusual field conditions.

## **Recommendations**

1. The Development Branch Habitat Development/Enhancement sections should survey other state wildlife agencies and land management agencies (e.g., U.S. Forest Service, BLM) that utilize outside vendors/contractors for water catchments or similar construction projects.
2. Evaluate and discuss liability issues, cooperating agency restrictions, and landowner concerns regarding the use of outside vendors/contractors for water development construction, maintenance, and redevelopment.
3. Evaluate the time/cost/value of outsourcing development and redevelopment of wildlife waters with contractors. Consider timeliness of getting urgent projects completed when other resources are committed.
4. Contracts for catchment construction, repair, or redevelopment should include a warranty clause, clearly defining length of time, repairs covered, and response time.
5. Utilize outside resources to complete environmental compliance documentation when feasible. Strive to group projects by geographical and administrative units (BLM, USFS, State Land, military), or pursue programmatic level NEPA documentation.

## **VI.5 ROLE OF VOLUNTEERS**

**Team Objective:** Assess water maintenance processes with regard to maximizing opportunities for use of volunteer resources in monitoring, inspection, and performing varying levels of maintenance and construction.

### **Issues**

#### ***Planning***

1. The Department has access to a large and diverse group of volunteers. We should evaluate and utilize the knowledge, skills, abilities, and interest of all current and future volunteers.
2. Volunteers have not waived liability for injury on Department sponsored projects.
3. Department staff do not have a thorough understanding of how some volunteer organizations communicate with their members and with other sportsmen or conservation groups.
4. Adequate planning will maximize the potential volunteer resource and minimize the amount of standby time.

#### ***Coordination***

1. A well-coordinated effort between the Regions and the Development Branch is necessary to plan, organize, implement, and evaluate projects.
2. Volunteers represent the Department in their conduct and work product. Volunteer projects need structure and supervision authority, to ensure that the program is meeting the Department's goals and objectives.
3. The Department must select tasks carefully making sure that assignments match volunteer capabilities and time constraints.
4. Volunteer projects should be coordinated with other Department Branches and Regions to avoid competing for volunteers.

#### ***Implementation***

1. Volunteers and Department staff participating on projects should receive adequate training to ensure their safety (e.g., tool use, proper lifting techniques).
2. The Department should regularly reward and recognize volunteers participating in water development projects (e.g., awards, verbal or written praise).
3. Volunteers and Department staff should have a clear understanding of their roles and responsibilities on any given project.

4. Good communication skills should be encouraged between the Department and external customers.
5. Clear written and verbal direction must be given to volunteers.
6. Safety must continue to be the highest priority on all projects, with compliance monitored by the Department and a member(s) of the volunteer organization. Department staff should be provided with basic first-aid training and adequate emergency supplies.
7. Time of the year, average temperature, and typical precipitation patterns may affect volunteer participation.

### ***Evaluation***

1. The Department should annually assess the monetary value of volunteer labor on water redevelopments, maintenance, monitoring, and other tasks and provide constructive feedback to its volunteers. Follow-up on this assessment should be incorporated into the Annual Work Plan process.
2. Volunteers should have an opportunity to provide feedback on their individual experiences, by providing constructive input.
3. A mechanism should be in place to record participation and provide volunteers with constructive feedback, benefiting from the successes and failures of previous projects.

### **Recommendations**

#### ***Planning***

1. Develop a Water Development Volunteer Program Guideline to help internal customers effectively utilize volunteer contributions.
2. Create a database to effectively match volunteer availability and capabilities with project needs.
3. Implement the requirement that all volunteers sign a “Waiver and Release of Liability” form recently drafted by the Attorney General’s Office.
4. Determine the appropriate forums by which to most effectively communicate the Department’s volunteer needs and opportunities to critical external customers (e.g., conservation organization board meetings, etc.).
5. Incorporate into the Annual Work Plan a project-planning template for all water developments, redevelopments, and maintenance actions that include opportunities (if any) for volunteer assignments.

### ***Coordination***

1. Create a prioritized list of potential volunteer projects for each Region/District to ensure the best use of volunteers.
2. Identify a project lead contact for each volunteer organization participating in Department water development projects.
3. Clearly identify supervisory roles for Department-sanctioned volunteer programs and projects.

### ***Implementation***

1. Provide training for volunteers on the proper operation of power tools, working outdoors, and general safety.
2. On and off the project site, establish clear leadership assignments for volunteers and Department personnel.
3. Ensure that proper tools, training and staff are available to implement a project.
4. Provide adequate direction, verbal or written, to Department personnel and volunteers participating in water development projects.

### ***Evaluation***

1. In the project completion reports produced by the Development Branch, include an assessment of volunteer participation including in-kind monetary value, and overall success with respect to defined objectives.
2. Provide volunteers on each project with the opportunity to give written and/or oral feedback on their experience.
3. Conduct field trips/workshops for volunteers and Department personnel to examine results of previous projects.

## SECTION VII. CUSTOMER RELATIONSHIPS

### VII.1 INTERNAL CUSTOMERS

**Team Objectives:** Identify internal customers of the Department's Water Development and Maintenance Program. Assess communications and relationships with these customers. Evaluate effectiveness of communication and relationships with these customers. Develop recommendations to improve relationships, if needed.

#### Issues

Key internal customers and process owners include the Development Branch, Director's Office, Commissioners, Regions, Game Branch, Habitat Branch, Information and Education Division, Finance and Accounting, Nongame Branch, and Research Branch. The Team identified a number of issues in need of attention, including:

1. Internal communications between work units are in need of improvement. There is also a lack of trust among some internal customers.
2. The Department needs to effectively promote its position and vision with respect to wildlife water developments.
3. Roles and responsibilities for water development planning, construction, maintenance, etc. are not clearly delineated.
4. Although unexpected projects will continue to occur, sudden and/or arbitrary changes in priorities can become a significant deterrent to effective planning and resource allocation. It also may create major workload issues and other scheduling problems. Without an annual work plan, these impacts cannot be accurately assessed and communicated.
5. The Department continues to acquire additional properties without fully evaluating the labor and financial impact on the Development Branch. In addition to these growing operation and maintenance needs, the Development Branch has numerous other maintenance responsibilities, both wildlife and sportfish-oriented, all contributing to a workload, which exceeds its annual capability.
6. Despite the critical role of water developments in managing big game species, the Game Branch has no formal role in the Department's water development program.
7. Consistent, effective two-way communication between the Development Branch and all Regions does not always occur, particularly with respect to reporting of maintenance and water hauling.
8. Status of external environmental compliance paperwork is often uncertain or difficult to verify. Copies of these documents need to be centrally archived and readily retrievable.

9. Research Branch is not fully integrated into water development-related issues. Improved communication to internal customers on waters-related projects would be advantageous.
10. Process ownership is sometimes unclear between Development Branch, Game Branch, and Regions when planning and implementing Special Tag Fund projects.

### **Recommendations**

1. Develop and implement an Annual Work Plan process that involves key internal customers (Section V, Planning).
2. Assign members of Development, Research, Game and Nongame Branches along with Regional staff to develop a “biological vision” document for the Department’s water development program that clearly articulates its mission and dispels myths. This would complement this Team’s effort, which focused primarily on the “how” of building and maintaining waters. The biological vision would establish the scientific basis, goals, and objectives of the water development program. The biological foundation for this vision statement has already been articulated in the 1997 Briefing Paper (and addendum) prepared by the Water Development Review Committee and a recent addendum to this document.
3. Implement the “biological vision” at Regional level through the Annual Work Plan process (Section V, Planning).
4. Delineate roles and responsibilities of critical Department personnel in water development- related activities (Section IV, Roles and Responsibilities).
5. Development Branch staff should use scheduled meetings and other established communication channels to better inform internal customers not directly participating in the Annual Work Plan on resource allocation and project commitments.
6. Game Branch should assign a staff person to participate in the Annual Work Plan process.
7. Develop an effective two-way communication process between Regions and Development Branch for achieving water-hauling and maintenance needs and documenting their completion.
8. Follow established Department procedures for expediting and tracking EA Checklist paperwork, while encouraging land management agencies to complete NEPA requirements in a timely manner.

### **VII.2 EXTERNAL CUSTOMERS**

**Team Objectives:** Identify external customers of the Department’s Water Development and Maintenance Program. Assess communications and relationships with these

customers. Evaluate effectiveness of communication and relationships with these customers. Develop recommendations to improve relationships, if needed.

### **Issues**

Key external customers are: land management agencies (Bureau of Land Management, Fish and Wildlife Service, Forest Service, National Park Service, State Land Department, Tribal Governments, U.S. Military); conservation groups (consumptive and nonconsumptive); individual wildlife users (consumptive and nonconsumptive); other citizens of Arizona; hunting guides; ranchers, and grazing permittees. The team identified a number of issues in need of attention, including:

1. Communications with external customers concerning the benefit of wildlife waters could be more effective. The Department often does not have a clear and consistent message understood by intended audience(s).
2. The value of wildlife waters to nongame wildlife is not widely appreciated nor understood. Waters are often erroneously viewed as only benefiting game species.
3. Interactions with external customers concerning allocation of Special Tag Funds are complex and could be better organized.
4. Consumptive and non-consumptive wildlife users not affiliated with user groups are not as well informed on waters-related issues.
5. Information and Education Branch communicates relatively little information on wildlife water developments.
6. External customers often erroneously assume that the Department is responsible for all wildlife water developments built and maintained by land management agencies. This is particularly problematic when those waters are nonfunctional or not properly maintained.
7. The Department needs to better document how resources are allocated and effectively communicate this information to external customers.

### **Recommendations**

1. Communicate through presentations, articles, video media, and other means the importance of water developments to Arizona's wildlife resources.
2. Research and identify current values of critical external customers and incorporate that knowledge into outreach efforts.
3. The Special Tag Fund allocation process should be mapped and analyzed for improvements, focusing on financial reporting, defining roles, establishing timelines and showing clear linkage to other work units.



4. Hold annual stakeholders workshop (as part of Work Plan process) that provides opportunities for input, discussion of budgets and plans, and identifies opportunities for volunteer involvement.
5. Increase contact with and support by the public not affiliated with consumptive or nonconsumptive wildlife groups.
6. Direct external customer communication and input to the appropriate level, agency, or owner (e.g., USFS waters to USFS District or Forest Supervisor Office, BLM waters to BLM Resource Area Office). Improve signage on all Department-managed water developments and include contact information (Section VII.3, Catchment Identification).

## SECTION VIII. WATER DEVELOPMENT CONSTRUCTION

**Team Objectives:** Identify construction-related elements affecting cost-efficiency and performance of water development projects (design, site selection, choice of materials, on-site project management, use of labor and equipment, catchment identification, and project evaluation). Develop specific recommendations to enhance success of new waters and redevelopments.

### VIII.1 SITE SELECTION

#### Issues

1. Some waters have been planned and implemented based largely on construction-related criteria, resulting in addition of waters that receive little wildlife utilization, or waters that do not meet clearly identified biological objectives.
2. Natural features affecting runoff capture and visual screening have not been fully utilized in catchment designs resulting in reduced efficiency and undesirable visual impacts.
3. Catchments have been built in locations where land use changes affected wildlife use and Department access for hauling, maintenance, or redevelopment.
4. When redeveloping catchments, a new system that meets Criteria for Success may not be feasible at the same location or within the existing footprint.

#### Recommendations

The Team developed specific recommendations for construction of new waters and redevelopment of existing facilities. To facilitate implementation of its recommendations, the Team developed a Project Planning Checklist (Appendix VII.1) for use in the Annual Work Plan process (Section V). Some of the Team's recommendations mirror those in earlier Department documents, including the 1996 *Water Development Program Evaluation Report* (prepared by Paul Tober, AGFD Development Branch) and the 1997 *Wildlife Water Developments Briefing Paper* (prepared by AGFD Water Development Review Committee). They are as follows:

1. Identify a clear biological need and measurable objectives for all new water development projects including local patterns of habitat use by target species and proximity/reliability of existing waters in project area.
2. Select sites that allow components to be easily camouflaged in the surrounding landscape.
3. Consider equipment and crew access requirements for future construction, maintenance, and water-hauling activities.
4. Consider and evaluate alternate locations when redeveloping catchments. Do not install a substandard system if that is all that is feasible on an existing site.

## VIII.2 DESIGN AND MATERIALS

### Issues

1. The majority of Department collection systems use fabricated aprons that are subject to degradation and damage by environmental factors.
2. Natural aprons represent a viable alternative to fabricated aprons, but have seen little use in Arizona. Natural aprons typically have minimal visual impact, lower construction cost, longer life span, and lower maintenance requirements. Desert Wildlife Unlimited (DWU) has successfully used natural aprons in southeastern California for  $\geq 20$  years.
3. Galvanized or black metal ring tanks are widely used storage systems, but have higher than desirable maintenance requirements.
4. Some storage systems are prone to failure due to poor materials, defective fabrication, or improper installation. Above ground Fiberglass tanks require periodic recoating to prevent deterioration (Photo Set D.1).
5. There has been a tendency to apply catchment designs that are overly complicated and labor intensive, resulting in reduced cost-effectiveness.
6. Major catchment components are sometimes not appropriately sized or matched, compromising catchment function. Common examples are aprons with inadequate collection potential, storage tanks with inadequate capacity, and supply pipes (between collection system and storage tank) that are too small to efficiently capture water from short-duration runoff events.
7. Potholes have high water loss due to evaporation and are typically placed in locations where hauling is difficult or extremely costly. Consequently, potholes can be less reliable water sources than more efficient catchment-type systems.
8. Some potholes with high masonry dams do not flush with runoff events, accumulate large volumes of organic matter, and may pose a risk of animal entrapment (Photo Set D.2).
9. New catchment designs that meet Criteria for Success will need to be developed for building and redeveloping waters for elk.
10. Most Department waters are fenced to exclude livestock and/or feral animals. Stranded wire fence has been used most often, but is not very durable and presents the risk of entanglement to big game species.
11. Catchment designs have placed little emphasis on visual impact; concerns that figure prominently in recent environmental challenges to the Department's Water Development Program (e.g., waters within the Sonoran Desert National Monument). Visual impacts are particularly important for waters in designated Wilderness areas (Photo Sets D.3, D.4).

## **Recommendations**

1. Modify the Department's approach to redeveloping and constructing new water developments, emphasizing materials and designs that meet the Criteria for Success. Recommended modifications include:
  - Avoid or minimize use of above-ground components (e.g., aprons, tanks, piping).
  - Camouflage above-ground components to the fullest degree possible (Photo Set D.3).
  - Maximize use of natural features for collection and visual screening (Photo Sets D.3, D.4).
  - Use durable and industry-standard liquid storage tanks, such as those manufactured for underground storage such as Xerxes, Inc., Anaheim, California).
  - Use passive systems (gravity fed, no float valves) whenever possible and cost-effective. In some redevelopment scenarios, it may be preferable to retain an existing float-valve delivery system.
  - Utilize pre-manufactured and or pre-assembled components that can be feasibly hauled to the site.
  - Plan for collection and storage components that meet expected wildlife needs during drought years.
  - Utilize designs that minimize evaporation loss.
  - Use hydraulically designed inlets and pipe sizing to maximize water interception from short-duration runoff events.
2. Enhanced tinajas and adits may be considered when their use will provide a reliable source of water at an optimal location.
3. When redeveloping potholes, allow for natural flushing of accumulated organic matter during heavy runoff events and design to divert sediment around the pothole, and minimize/eliminate chances for animal entrapment.
4. Develop new catchment designs appropriate for use in elk habitat. This effort should incorporate experience with waters for other species that meet Criteria for Success.
5. Use the Department-approved design for pipe rail fencing at all projects. Avoid the use of wire fence.
6. Develop a design, peer evaluation, and follow up monitoring protocol to encourage innovative ideas and materials testing, which may enhance standardized options.

7. The Engineering section and Habitat Enhancement/Development sections must assign appropriate staff to prepare a “standards” design manual that covers a glossary of standardized terms and materials, design details, and construction methods for water developments that meet Criteria for Success. This should be an immediate priority once recommendations in this report are accepted and implemented. The “Bighorn Sheep Water Development Standards” will remain as the primary reference for water developments targeting this species. This document must continue to be updated collaboratively with the ADBSS, with consideration to the “criteria for success” as well as consistent linkage to the construction standards manual proposed in this Report.



**Photo Set D.1. Examples of Problematic Storage Systems.**

**Top** – leaking above-ground sausage tank (#788) that failed at overflow. **Bottom** – Fiberglass sausage tanks at very remote site accessible only by helicopter (#1041). Above ground Fiberglass tanks like these require coating to minimize damage from weathering.



**Photo Set D.2. Examples of Potential Problems Posed by Pothole-Type Catchments.**

**Top** – pothole (#357) with high dam that prevents flushing during runoff events. Accumulation of animal feces and other organic matter may create conditions conducive to water quality problems. **Bottom** – bones of entrapped animals (mule deer and desert bighorn) that died and decomposed in similar high-dam pothole (#806) with steep sides and no escape ramp.





**Photo Set. D.3. Examples of Catchment Visual Impacts.**

**Top left** – apron catchment and above-ground sausage tanks (#995) in designated wilderness area. Waters like this have been a focal point in recent challenges by environmental groups.

**Middle left** – large uncamouflaged ring tank (#535). **Bottom left** – similar ring tank (#755) camouflaged to blend in with surrounding area.

**Top right** – DWU-style catchment (#1030) with minimal visual profile. Storage tank is buried immediately behind drinker, “natural apron” collection point is a small dam located up wash (out of photo).



**Photo Set D.4. Example of Low Visual Profile DWU-Style Water Built In Desert Bighorn Habitat in California.**

**Top** – distance view of location, catchment is located just above cement mixer at center of photo. **Bottom** – close-up of system. Storage tank is located under “artificial” rock that construction crewmember is standing on.



### **VIII.3 CATCHMENT IDENTIFICATION**

#### **Issues**

1. Many waters, particularly those owned or maintained by other agencies, are not signed. This creates confusion concerning catchment ownership and maintenance responsibility.
2. Signage at Department water developments does not always provide essential information (e.g., name, ID number, maintenance responsibility, funding source) or a means to report problems. Many identification signs are in poor condition (Photo Set D.5).
3. Some catchments have multiple names or differing agency numbers, creating additional confusion. Catchment numbering and naming has not been well coordinated with other land management agencies.

#### **Recommendations**

1. Install uniform signage (Photo Set D.5) on all wildlife waters owned or maintained by the Department. Cooperators, land management agencies, or sportsmen groups may install additional signage if appropriate. Standardized signs should be designed as follows:
  - Approximately 8"x10" or smaller in size, colored with earth tone colors, and fabricated from steel, cast bronze alloy, or aluminum. Lettering and graphics should be permanent.
  - Provide information regarding catchment name and number, management ownership and maintenance responsibility, funding source, partners that participated in the project, agency logos, contact phone number to report problems or other information.
  - Secure signs to rigid object (e.g., a fence post, pipeline support, apron framing, large rock). Signs are subject to vandalism by shooting and should be positioned to avoid collateral damage to catchment components.
2. Monitor sign applications for durability and make adjustments as indicated.
3. Circulate a proto-type sign to critical internal and external customers for evaluation.
4. Develop an action plan to produce and install approved signs at all Department waters. Include individual assignments and deadlines.
5. Place notice in Department Hunt Regulations indicating that some wildlife waters are owned/maintained by other agencies, and explain how to recognize Department-managed waters (include illustration of standard sign).



**Wildlife Water Catchment**



This water development was built to provide wildlife with a reliable source of water. If there is no water present or other problems, please call the number listed below. Thank you.

Catchment name and number:

Agency Responsible for Maintenance:

Funding source:

Project Cooperators:

**Photo Set D.5. Examples of Signs at Various Department Waters.**

**Bottom right** – suggested template for standard sign that would be used at all Department waters.

6. Encourage and support other management agencies in identifying water catchments that they own/maintain, using the new standards recommended in this report. If funding is an issue, assist the agency in finding assistance.

#### **VIII.4 ON-SITE PROJECT MANAGEMENT**

##### **Issues**

1. Effective on-the-ground supervision of water developments is needed to ensure components are correctly installed and completed with greatest possible efficiency.
2. Lack of clear leadership roles is often a problem, particularly in cooperative projects with external groups. In some cases, this has resulted in disagreements over construction procedures and undesirable deviations from project plans.
3. ARS 32-142 states that “drawings, plans, specifications, estimates and construction observation for public works of the state or a political subdivision thereof involving architecture, engineering shall be under the direct supervision of a registrant within the category involved.”

##### **Recommendations**

1. Assign an AGFD lead for all cooperative projects, who has ultimate responsibility for on-the-ground organization, decision-making, in-progress and final inspections (by engineering staff), and completion of as-built drawings. This is especially important for projects that will be maintained by the Department.
2. It is essential that the Department obtain buy-in from external stakeholders on project design, materials and implementation methods before work begins.
3. Minimize deviations from specified plans and avoid “experimentation” during construction.

#### **VIII.5 LABOR AND EQUIPMENT**

##### **Issues**

1. Construction and redevelopment projects require efficient allocation of personnel and equipment. However, these resources are not always allocated optimally, resulting in increased cost and slowed project completion.
2. There is a tendency to emphasize hand labor over equipment, on projects undertaken with volunteer groups. However, there may be projects for which this is acceptable given the time/cost/value of the volunteer resource.

##### **Recommendations**

1. Maximize use of equipment versus manual labor when feasible on projects being constructed

by Department crews.

2. Improve project coordination to schedule skilled equipment operators and well-trained volunteers.

## **VIII.6 PROJECT EVALUATION**

### **Issues**

1. Clearly articulated objectives generally have not been established for Department wildlife waters, particularly at the project level.
2. Follow-up monitoring and evaluation of waters has been limited. There is limited data on performance of various components and system designs, reducing opportunities to learn from past successes and failures.

### **Recommendations**

1. Implement a system for evaluating water development performance. Evaluation criteria should reflect biological objectives specified in the Project Planning Checklist and Criteria for Success articulated in this report.
2. Develop a process to schedule inspections of recently redeveloped or newly constructed tanks. Ideally, the water developments would be inspected 30 days and 12 months after completion. This could be accomplished by willing volunteers.

## **SECTION IX. WATER DEVELOPMENT MAINTENANCE**

**Team Objective:** Assess Department procedures for maintaining wildlife waters and develop recommendations for improvement.

### **Issues**

1. The Department is faced with a significant maintenance burden, due to the large number of aging catchments and design-related flaws and installation deficiencies.
2. Regional Offices do not have all the resources they need to effectively assume their designated maintenance responsibilities.
3. Wildlife Managers may need to increase their level of involvement to support objectives of the Department's Wildlife Water Development program.
4. In cooperative water projects undertaken with other land management agencies, cooperator responsibilities are often not clearly delineated in proposals or collection agreements.
5. Some cooperators do not assume responsibility for maintaining waters and are unresponsive when informed of maintenance needs. The Department receives insufficient or no information on maintenance performed on waters by other agencies.
6. Many cooperating agencies lack information on location and functional status of their catchments.
7. Wildlife waters built by land management agencies may not meet the Department's proposed Criteria for Success (Section A.1).

### **Recommendations**

1. Construct and redevelop waters in a manner that minimizes long-term maintenance needs (Section VII).
2. Develop a "water catchment repair kit" and provide to Wildlife Managers. Place cache of common repair supplies (e.g., float valve assemblies, underwater epoxy) at each Regional office.
3. Develop a list of approved outside contractors/vendors and potential volunteers for each Region, to assist with emergency water hauling when necessary. Military assistance (training activities, etc.) should also be vigorously pursued to help fulfill emergency water-hauling needs.
4. Increase training for Wildlife Manager trainees and other staff, providing skills necessary to make simple repairs to wildlife waters. Training could be provided at the Regional offices, Department School, or by personal mentoring.

5. Develop a water catchment logbook for each WM District, including historic information, system description and plumbing schematic, site maps, and other pertinent information.
6. Ensure that new grants and collection agreements include specific verbiage regarding cooperator responsibilities for monitoring and maintenance.
7. Encourage public land management agencies, including state and regional level leadership, to allocate resources to the management of wildlife water developments.
8. Develop opportunities for maintenance and monitoring by volunteers (See Section V., Planning; and Section VI.4, Role of Volunteers).
9. Develop an interagency database of wildlife waters statewide (Section IX.3, Database Needs). Include all water-hauling activities by the Development Branch, the Regions and volunteers.
10. Work more closely with other agencies in developing wildlife waters, and offer to review their plans and designs.
11. Establish a routine, proactive maintenance program that will identify potential problems and affect remedies before bigger problems occur.

## **SECTION X. WATER DEVELOPMENT MONITORING**

**Team Objectives:** Evaluate current wildlife waters monitoring practices, particularly water hauling and maintenance needs. Develop recommendations for more efficient collection, storage, and dissemination of monitoring information.

### **X.1 MONITORING PROCEDURES**

#### **Issues**

1. Frequency and intensity of water development monitoring varies greatly across the state. In many cases, the basic information needed for effective wildlife waters management is lacking or not available in a timely manner.
2. Volunteer resources are willing and able to assist the Department in this important component of the water development program but must be closely coordinated to prevent duplication of effort.
3. Catchment component failure and water depletion during critical periods may go unnoticed because of inadequate monitoring or lack of timely reporting.
4. Monitoring data are needed to ensure timely catchment maintenance and water hauling.
5. Monitoring data are not centrally archived or readily retrievable to Department personnel and external stakeholders.
6. Monitoring can be difficult and even dangerous during certain parts of the year.

#### **Recommendations**

1. Each Region will implement a standardized monitoring protocol that collects needed data. Monitoring data collected should include water level, depletion rate, catchment condition, maintenance/repair needs, and signs of wildlife use.
2. Regions and Development Branch should identify opportunities and needs for volunteer monitoring support (See Section VI.5 - Role of Volunteers).
3. Wildlife Managers should maintain a file or database describing water location, access, configuration, and storage capacity of all waters in their District.
4. Each Region should maintain a central database containing monitoring information collected by Wildlife Managers and other Department personnel.
5. Use monitoring data to identify current or anticipated maintenance needs and estimate expected dry dates of catchments.

6. Regional personnel should communicate water-hauling and maintenance requests (preferably in writing) to Development Branch at least one work period (two weeks) in advance of water depletion or catchment failure. Develop a protocol to handle emergencies.
7. Hauling and maintenance activities by Development Branch should be communicated back to the Region within two days of end of the work period.

## **X.2 REMOTE SENSING**

**Team Objective:** Assess the feasibility of measuring and transmitting precipitation and water level data from remote water catchments. Design and test a prototype system (currently in progress).

### **Issues**

1. Wildlife Managers and other Department personnel expend a tremendous amount of time and effort monitoring wildlife waters. Monitoring is particularly challenging for remote waters that are difficult to access by vehicle, or not readily observable from the air.
2. Development Branch is conducting a multi-year examination of systems for remote, real-time monitoring of rainfall and flow data. Equipment used by Maricopa County Flood Control District (MCFCD) and the Arizona Department of Water Resources appears suitable to meet Department objectives.
3. MCFCD has indicated that they are considering additional monitoring locations so it may be possible for the Department to “piggy-back” on their system, as long as our installations are compatible. This cooperative arrangement would reduce cost to the Department, by delivering information over the Internet and eliminating the need for a separate transmission network.

### **Recommendations**

1. Test prototype installed under one of the following two alternatives: (1) At a water development that is difficult to monitor, either from the ground or by air. Suitable candidate sites include Montezuma Tank (#814) and Butterfly Tank (#808) in the Sierra Estrella Mountains. (2) At an easily accessed location by foot or vehicle. Los Sientos development (#1021) in the Buckeye Hills is a suitable site within 1,000 yards of a two-track road.

## **X.3 DATABASE NEEDS**

**Team Objective:** Evaluate current Development wildlife waters database, identify additional database needs, and make recommendations for improvement.

### **Issues**

1. Information on wildlife waters exists in multiple databases and formats, and is inadequate for effective management and information retrieval.



2. The Development Branch may not have the personnel to develop and manage an expanded database system.
3. Some conservation groups have requested that the Department take the lead in developing a statewide database of all wildlife waters.
4. There has been a previous attempt to develop an interagency database; however, priorities and data management protocols vary among responsible agencies. Issues of data ownership and management also have to be resolved.

### **Recommendations**

1. Take the lead in assembling an interagency and stakeholder team to develop a statewide water development database. This effort should include surveys to identify information needs of internal and external customers and an assessment of risks/benefits associated with public access to database information.
2. Evaluate current Development Branch staffing to determine if existing staff can assume database maintenance responsibilities.
3. Restructure as necessary the Department's water development database to achieve the following minimal criteria:
  - Provide accurate information regarding maintenance history and current maintenance needs, and redevelopment options.
  - Accurately track water hauling, including supplementations by Wildlife Managers, contractors, and volunteers.
  - Provide accurate location and descriptive data.
  - Use or be compatible with commonly used software (e.g., MS Access).
  - Meet internal and external customer needs.
  - Allow for queries on various data attributes and generation of reports.
  - Allow for convenient input and modification of data.
4. The database should be GIS compatible and include the following attributes:
  - Catchment name and aliases
  - Date of construction
  - Target species
  - Miscellaneous notations from observers
  - Catchment features. Type and size of collection systems, storage systems, drinkers, fences, etc.
  - Elevation and vegetation community
  - Ownership and maintenance responsibility
  - Location (USGS Quad, UTM Coordinates, Latitude/Longitude)
  - Identification number (uniform system)

- Primary wildlife species using the water
- Partners/cooperators involved in project
- NEPA history
- Monitoring history
- Incidental information such as wildlife mortality events
- Water-hauling history
- Maintenance history, including expenditures
- Access (e.g., vehicle, helicopter, or by hiking)
- Land ownership and status
- Reliability (perennial, seasonal, etc.)

## APPENDIX I.1

### PRELIMINARY LIST OF PRIORITY CATCHMENTS FOR REDEVELOPMENT

This list was prepared using existing records that may not include recent redevelopment projects. It includes only water developments managed by the Department. The list is likely to change after completing a statewide Annual Work Plan and site evaluation.

#### **First Priority**

Catchments (77 total) that require excessive water hauling and may have failure-prone components. Coded as follows: W = excessive water hauling, WA = excessive hauling plus failure-prone apron, WR = excessive hauling plus failure-prone ring tank, WAR = excessive hauling plus failure-prone apron and ring tank.

***Region I:*** none

***Region II*** (25):

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254W	260WAR	374W	643W	971WR
255W	330W	391W	651W	972WR
256W	332W	624W	666W	973WR
258W	372WAR	625W	685W	974WR
259W	373W	641W	686W	1019WR

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***Region III*** (2): 413WAR, 775WAR

***Region IV*** (36):

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395WAR	447W	529WAR	595WAR	610WAR	738WAR
416WAR	448W	541WAR	596WAR	660WAR	754WR
417WAR	450W	542WAR	597WAR	661WAR	864WAR
441WAR	451W	543WAR	599W	672W	876WAR
442WAR	452WAR	544WAR	607WAR	673W	936WR
443W	528WAR	545WAR	608WAR	737WAR	1027WR

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***Region V*** (11):

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47W	103W	908W
51W	104W	991WR
52W	105W	1020WR
100W	106W	

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***Region VI*** (3): 76W, 679WAR, 719WA

**Second Priority**

Catchments (124 total) that have failure-prone apron **and** ring tank.

***Region I*** (1): 431

***Region II*** (13):

257	818	837
758	825	838
816	828	896
817	829	907
		925

***Region III*** (35):

670	759	772	781	819	859	891
729	760	774	782	820	860	904
745	761	776	783	830	877	905
746	765	779	809	831	878	920
747	771	780	810	832	886	924

***Region IV*** (42):

396	530	536	584	609	636	726	892	937
397	531	580	594	611	659	777	928	938
518	532	581	598	627	711	792	929	1000
520	533	582	605	628		811	930	
521	534	583	606	629	713	848	933	

***Region V*** (25):

676	695	799	880	895
677	723	800	882	909
688	752	801	883	910
689	791	858	885	911
694	798	866	889	914

***Region VI*** (8): 191, 554, 691, 784, 785, 786, 787, 788

**Third Priority**

Catchments (72 total) that have failure-prone apron **or** ring tank. Coded as follows: A = failure-prone apron, R = failure-prone ring tank.

***Region I*** (2): 1023R, 921A

***Region II*** (12):

618A	757A	906R	997R	999R	1018R
756A	887R	940A	998R	1017R	1026R

***Region III*** (11):

739R	769A	955R	1033R
740R	770A	968R	1052R
743A	923A	987R	

***Region IV*** (24):

394R	601R	918R	946R	957R	967R
519R	602R	941R	947R	958R	969R
523R	720A	943R	948R	963R	970R
535R	721A	945R	950R	966R	983R

***Region V*** (12):

49R	748A	873A
111R	749A	902R
112R	868A	989R
690R	872A	994R

***Region VI*** (11):

718A	901A	978R	1057R
725A	975R	1037R	1072R
727A	977R	1038R	

## **APPENDIX I.2**

### **DRAFT SCORING PROCESS FOR PRIORITIZING WATERS**

*Procedure:* Score development for each criterion listed below. Higher total score equals higher priority (maximum possible = 100 points).

#### **Catchment condition and function (50 points)**

- expected lifespan of major components (collection, storage)
  - >10 years = **2**
  - 5-10 years = **5**
  - <5 years = **10**
- supplemental hauling requirements
  - none = **0**
  - hauling required, <1 load/year on average = **2**
  - 1-2 loads/year = **10**
  - ≥3 loads/year = **20**
- specialized required equipment for hauling
  - none = **0**
  - 4wd truck = **2**
  - helicopter = **10**
- 1-way travel time from hauling source
  - ≤ 1 hr = **0**
  - > 1 hr = **5**
- visuals: major components (collection, storage, piping, drinker)
  - in obvious disrepair, = **5**
  - painted or otherwise partially camouflaged = **2**
  - out of view or totally blended into surrounding landscape = **0**

#### **Biological factors (30 points)**

- distance to nearest other reliable water source
  - ≤ 4 mi = **3**
  - >4 mi = **10**
- water is critical for
  - 0 big game species = **0**
  - 1 big game species = **10**
  - >1 big game species = **15**
- water is important to nongame, T&E, other high profile species
  - yes = **5**
  - no = **0**

#### **Public access/land management (10 points)**

- public access for hunting/recreational purposes
  - unrestricted = **5**
  - limited = **2**
  - none = **0**
- other conflicts (urban encroachment, incompatible land uses)
  - present = **0**

absent = **5**

**Environmental Compliance (10 points)**

- maintenance or redevelopment addressed in existing land management plan  
yes = **3**  
no = **0**
- NEPA documentation complete  
yes = **7**  
no = **0**

**APPENDIX I.3**  
**WATER DEVELOPMENT PROJECT PLANNING CHECKLIST**

This checklist should be prepared by Regional staff (with support from Development Branch and other work units as needed) prior to the Annual Work Plan meeting.

**Site Selection**

1. List specific biological objectives for the project, including species expected to benefit and desired changes in their density, distribution, etc.
2. Attach a copy from USGS 7.5 minute topographic or other similar quality map, showing the location of proposed project and nearest reliable water source(s) accessible to species listed above.
3. Is the proposed project within the anticipated area of use for the target species listed above?  
If not, explain why.
4. How can the proposed location be accessed for construction, maintenance, and water hauling if needed?

**Design**

1. Describe the overall design of the system (collection, storage, and drinking trough), including detailed plans and materials list.
2. Estimate animal density and average daily consumption to determine storage capacity.
3. Given watershed size and local precipitation pattern what size pipeline is needed to fill the storage system?
4. Describe what steps will be taken to reduce water loss due to evaporation.
5. What moving parts, if any, will be included in the system?
6. Describe how the system components will be camouflaged with the surrounding landscape.
7. If a pothole system, describe features that will allow for periodic flushing and prevent animal

entrapment.

### **Materials**

1. Which components will be pre-assembled or pre-manufactured prior to delivery?

### **On-site Project Management**

1. Identify AGFD Project Lead who will supervise and coordinate construction.
2. Identify one or more volunteers who will supervise and coordinate construction.

### **Use of Labor and Equipment**

1. List specific mechanical or motorized equipment required to complete the project.
2. Identify number of people and respective skills needed to complete the project.
3. List sequence of major steps in construction and the specific equipment and people needed for each.